Effect Of Bovine Colostrum On Zootechnical Parameters And Egg Production In Goliath Chickens In An Experimental Setting

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Abstract

The objective of this study was to evaluate the effect of bovine colostrum on the growth, survival, and egglaying performance of Goliath chickens raised for 20 weeks at the experimental site of the Faculty of Agronomy of the University of Niamey. A total of 180 chicks were divided into three homogeneous groups receiving a basic diet supplemented with 0% (T0), 1% (T1), and 2% (T2) colostrum during the first 21 days of life. The parameters studied were live weight, feed intake, average daily gain (ADG), feed conversion ratio (FCR), mortality rate, age and weight at the start of laying, and egg weight. The data collected were analyzed using Tukey's test, using R software (version 4.4.0.). The results revealed a highly significant difference (p=0.0044) in weight during the start-up phase (1-3 weeks) between the control group and the T1 and T2 treatment groups. A significant difference was also observed between T1 and T0 with a p-value <0.05. This trend continued until the end of the trial. At the end of the trial, the weights of the hens were statistically different (p=0.00009). In fact, the hens in the 2% group had a weight at the start of laying of 1484.76±135.75g, and an egg weight of 27.50±0.5g at week 18. For the 1% group, the weight at the start of laying was 1249.118±113.73 g with an egg weight of 25 g. In the control group, the weight at the start of laying was 1280.30±149.57g (week 19), with an initial egg weight of 27.33±1.76g. Colostrum can be used as a feed additive for poultry to improve productive and reproductive performance (egg laying), while reducing mortality rates at start-up.

Keywords: Goliath chicken, bovine colostrum, growth, egg laying, mortality, Niamey-Niger

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I. Background

Colostrum is the first milk produced by mammals after giving birth. This biological product plays a fundamental role in the health and development of calves, far beyond its function of providing passive immunity. In addition to the immunoglobulins it provides to protect newborns against environmental pathogens (Hammon et al., 2013; Lopez and Heinrichs, 2022), it is particularly rich in essential nutrients and antimicrobial factors such as lactoferrin, immunoglobulin, lactoperoxidase, etc., as well as vitamins that promote the development of the immune system. It is particularly rich in essential nutrients and antimicrobial factors, such as lactoferrin, immunoglobulin, lactoperoxidase, etc., and vitamins that promote the development and proper functioning of the intestine (Cabrera et al., 2013; Nili et al., 2013; McGrath et al. 2016; Agbokounou et al., 2017). These specific components, such as cytokines, lactoferrins, and hormones, contribute to the maturation of the intestinal mucosa, improved nutrient absorption, and the establishment of a balanced intestinal microbiota (Hammon et al., 2013). This bioproduct plays a decisive role during the first 15 days of life, particularly in sensitive neonatal species such as piglets and kids (Godhina and Patel, 2013; Nili et al., 2013; Bandrick et al., 2014; Abdou et al., 2014; Rathe et al., 2014, and Hammon et al., 2020). According to these authors, the administration of bovine colostrum is a key phase in ensuring optimal growth, improved immune resilience, and a considerable reduction in digestive disorders in young mammals. The physicochemical composition and biological functions of colostrum are not identical to those of mature milk. This difference is mainly due to the high content of immunoglobulins, growth factors, and other essential nutrients in colostrum,

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which are present in higher quantities than in milk. The transition from colostrum to mature milk is therefore a crucial dietary change that can influence the health status of young mammals, particularly calves (Fahey et al. 2020). According to Fahey et al. (2020) and Ilke (2023), an unbalanced intake of colostrum can compromise the immune development and health of newborns. In monogastric animals, particularly poultry, although they do not receive colostrum naturally, several studies (Y de Vries et al., 2018; Parapary et al. 2021; Arjomand et al. 2021) have shown that exogenous colostrum supplementation in their diet regulates heat stress and improves growth and production performance. This bioproduct is readily available from dairy cows, which produce sufficient surpluses to cover the needs of calves (Afzal et al. 2018). Dietary supplementation with up to 2% colostrum has shown positive effects on the productive and health performance of chickens, with no adverse effects on their overall health (Zhang et al., 2016; Del Puerto et al., 2017; Afzal et al., 2018 and Parapary et al., 2020). This is why we focused this study on testing the effect of bovine colostrum on zootechnical parameters and the age at which Goliath chickens in Niger start laying eggs.

II. Materials And Methods

Study area

The study was conducted from January 1, 2025, to May 30, 2025. It was carried out at the experimental site of the Faculty of Agronomy at Abdou Moumouni University in Niamey, Niger. This site is located in the fifth municipal district of Niamey. The city of Niamey is geographically located at latitude 13°28" and 13°35" north and longitude 2°03" and 2°10" east (INS-Niger, 2018 and 2022). The municipal district lies between 2°6'55" east longitude and 13°30'5" north latitude and covers an area of 40 km2. The temperature varies from 15°C (minimum) in December-January to 45°C (maximum) from March to June.

Biological material

The research protocol was validated by the Animal Feed and Nutrition Laboratory (LANA) of the Faculty of Agronomy at the University of Niamey. A total of one hundred and eighty (180) day-old Goliath chicks were used. Colostrum was administered to the chicks during the first twenty-one days. The control group was fed the basic feed (T0: 0%), and the test groups received colostrum supplements of 1% (T1: 1%) and 2% (T2: 2%). For every 1kg of feed distributed, 10g (1%) or 20g (2%) of colostrum was added. The birds were vaccinated against Newcastle disease, Gumboro disease, and infectious bronchitis on days 7, 10, and 13, with boosters on days 21, 24, and 27, in accordance with the vaccination schedule for birds in Niger.

Data analysis and processing.

The data collected were recorded and processed in an Excel spreadsheet. Data analysis was performed using the two-factor ANOVA method with R software (version 4.4.0), and Tukey's test was used to compare means at a 5% threshold when there was a significant difference between the different feed treatments.

III. Results

Changes in live weight of chickens

Overall, there was a gradual increase in the live weight of Goliath chickens in the treatment groups from week one (1) to week twenty (20). The initial weight was consistent across the three groups, ensuring a fair distribution basis (P-value = 1.00). However, a highly significant difference (p=0.0044) was observed during the start-up phase (weeks 1-3) between the control group and the T2 treatment group. The difference was significant between T1 and T0 with a p-value <0.05. This difference was maintained until the end of the trial. During this period, the treated groups had significantly higher average weights, with a dose-dependent effect: T2 > T1 > T0 (Table 1). At week 20, the trend was favorable for treatment T2, with differences no longer statistically significant (P> 0.05) between the groups that received colostrum.

Table 1: Effect of colostrum on live weight in g

Age	T0	T1	T2	P-value
(in week)	(0% of colostrum)	(1% of colostrum)	(2% of colostrum)	
Pi	32.9±3,69	32.9±4.34	32.9±3.32	1.00
1-3	132.02± 28.18**	146.94±33.22**	165.51±33.31***	0.0044481
4-12	$745.88 \pm 107.85^*$	766.90±114.71*	931.50±128.53***	0.0001
13-20	1454 21+245 78***	1606 33+358 14*	1703 33+214 93*	0.008

All values marked with *** indicate a highly significant difference, values marked with ** indicate a significant difference, and values marked with * indicate that the difference is not statistically significant.

Pi: initial weight

Effect of bovine colostrum on average daily gain (ADG) and feed conversion ratio (FCR)

Comparative analysis of the zootechnical performance of chicks given different doses of bovine colostrum (0%, 1%, and 2%) reveals a significant difference between the control group and the colostrumtreated groups (T1 and T2) in the parameters evaluated (ADG and FCR). At the start of the trial (weeks 1 to 3), the chicks in the 2% group had a highly significant ADG (p=0.002911) compared to the control group and the 1% group. At the end of the trial, the chickens in the 1% group set a record with an ADG of 13.65±5.77 g/day/subject, with a statistically significant difference. Regarding IC, from the start to the end of the experiment, it was similar in chicks receiving colostrum, and the control group had a relatively lower IC (6.93 ± 1.88), with no significant difference (p<0.05) between the batches (Table 2).

Table 2. Effect of bovine colositatii on ADG and ic in greating phase						
Zootechnical	Week	T0	T1	T2 (2% ofcolostrum)	P-value	
parameters		(0% of colostrum)	(1% ofcolostrum)			
	1-3	4.71± 1.26**	5.43± 1.50**	6.31± 1.56***	0.002911	
ADG	5-12	9.10 ± 1.43*	9.20 ± 1.77*	12.15± 2.00***	0.001	
	13-20	11.14± 2.86*	13.65± 5.77***	11.99 ± 4.05*	0.0059785	
T 1: 1	1-3	1,96± 0,55***	1,74± 0,49**	1,51± 0,41**	0,0000053	
Indice de	5-12	4,02 ± 0,68***	4,65 ± 0,78***	3,49 ± 0,53***	0,0001054	
Consommation	13-20	6,93 ± 1,88*	7,04± 2,19*	7,77 ± 3,13°	0,21	

Table 2 · Effect of bovine colostrum on ADG and IC in g/rearing phase

Effect of bovine colostrum on feed intake

During the start-up phase until the end of growth, the chickens in the three groups had similar feed intake. This intake increased gradually with age for all groups. At the end of the trial, chickens in the 2% group had higher feed intake (85.30 g/subject/day), followed by the 1% group and the control group from the start to the end of the experiment (Figure 3).

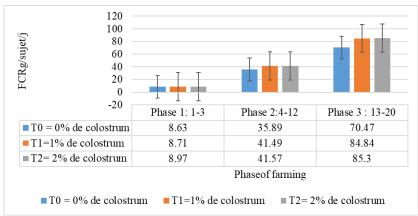


Figure 3: Effect of bovine colostrum on CA by rearing phase in g

Mortality rate

The mortality results are shown in Table 3. As the incorporation dose increases, mortality decreases at all age stages. The 2% treatment consistently performs best, with a total mortality rate of 4.99% compared to 11.66% for T1 and 18.29% for T0 (Table 3).

Table	3	:	Mortality	rate
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Age (Week)	T ₀ (0% ofcolostrum)	T ₁ (1% of colostrum)	T ₂ (2% of colostrum)	Total
0-3	8.33	5	3.33	16.66
3-12	6.66	3.33	1.66	11.65
12-20	3.33	3.33	0.00	6.66

Age at first lay and egg weight

Table 4 shows the change in hen weight at the start of laying (weeks 18-20) and the weight of eggs laid according to the colostrum treatment dose. Hen weight increases gradually with age regardless of the type of treatment, with a statistically significant difference (p=0.00009) between the 2% treatment and the other groups. No statistical difference was observed between the control treatment and the 1% treatment. However, the 2% group had a higher weight, with the 1% group in an intermediate position and the control group (weeks 18-20). Egg weight increased with age. No difference is statistically significant (p>0.05). The results also show that the eggs from treatment T2 are heavier, followed by T1 and T0.

^{*:} no significant difference; **: significant difference; ***: highly significant

Age en

Table 4: Age at start of laying, weight of hens and eggs in g						
T_0	T_1	T ₂	P-value			
(0% of colostrum)	(1% of colostrum)	(2% of colostrum)				
1211.80±153.63*	1249.118±113.73*	1484.76±135.75***	0.001			
1280.30±149.57*	$1328.70 \pm 135.05^*$	1559.23±153.26***	0.001			
1348.16±150.27*	1427.03±188.24*	1628.33±176.24***	0.00009			

semaine 18 19 20 Effectif 29 39 Egg weight 18 0 27.50±0.5 0.212 32.40 ± 2.20 27.33 ± 1.76 19 28.50±1.83 0.252 20 3.16 ± 1.07 32.42±2.36 36.11 ± 2.11 0.267

IV. **Discussion:**

In this study, the initial weight of the chicks was consistent across the three groups (P-value = 1.00), indicating a balanced distribution at the outset, consistent with the work of (Afzal et al. 2018). However, a highly significant difference (p=0.003) was observed during the start-up phase (weeks 1 to 3) between the control group and the groups receiving colostrum (T1 and T2). This difference persisted until the fourth week, following a dose-dependent effect: T2 > T1 > T0. These results are consistent with those of Parapary et al. (2021), who also found a significant variation in weight depending on the doses of bovine colostrum administered to Ross-308 chickens during the first 10 days (0%: 143.13g; 0.5%: 147.05g; 1%: 150.38g; 1.5%: 152.84g, and 2%: 146.82g). Beyond the first four weeks, no statistically significant differences were observed, although the group receiving 2% colostrum maintained a higher average weight during weeks 4-20. These results contrast slightly with those of Parapary et al. (2021), who identified better weight gain with 1.5% colostrum supplementation. Bovine colostrum is recognized as a beneficial feed additive for birds.

Ce bioproduit améliore progressivement le gain de poids corporel, grâce á sa richesse en nutriments et de sa composition physico-chimique nutritionnelle. Toutefois, les résultats de la présente étude ne concordent pas avec ceux d'Arjomand et al. (2022), qui n'ont observé aucune différence significative de poids selon les doses de colostrum administrées durant les dix premiers jours de vie des poussins Ross-308. Les résultats de la présente étude indiquent que la supplémentation en colostrum bovin, en particulier á hauteur de 2%, a eu un effet positif sur l'amélioration de la consommation alimentaire et du gain moyen quotidien des poulets Goliath. Cette amélioration peut être attribuée á la richesse du colostrum en nutriments essentiels, en facteurs de croissance, et en immunoglobuline qui favorisent une meilleure digestion, une utilisation plus efficace des nutriments et une meilleure croissance. Le lien étroit entre la consommation alimentaire et le gain moyen quotidien s'explique par le fait qu'une augmentation de la consommation permet un apport énergétique et protéique plus important, contribuant directement à une croissance pondérale accrue.

This bioproduct gradually improves body weight gain thanks to its rich nutrient content and nutritional physicochemical composition. However, the results of this study do not agree with those of Arjomand et al. (2022), who observed no significant difference in weight according to the doses of colostrum administered during the first ten days of life of Ross-308 chicks. The results of the present study indicate that supplementation with bovine colostrum, particularly at a level of 2%, had a positive effect on improving feed intake and average daily weight gain in Goliath chickens. This improvement can be attributed to the richness of colostrum in essential nutrients, growth factors, and immunoglobulin, which promote better digestion, more efficient nutrient utilization, and better growth. The close link between feed intake and average daily gain can be explained by the fact that increased intake provides a higher energy and protein intake, directly contributing to increased weight gain.

These results prove that adding up to 2% bovine colostrum not only optimizes growth but also nutrient utilization, making it a nutritional additive that promotes improved performance in Goliath chickens. These observations are consistent with those of Bayril et al. (2017), as well as Mokhtarzadeh et al. (2022) and Mokhtarian et al. (2023), who also reported beneficial effects of bovine colostrum on the growth performance of Japanese quails in Iran. Furthermore, these results are consistent with those of Hamani et al. (2022), who showed that replacing 50% of fish meal with maggots significantly improved feed intake and average daily gain in local chickens in Niger. This highlights the value of using local and functional nutritional alternatives to optimize zootechnical performance. Thus, the integration of bovine colostrum into feed could be a promising nutritional strategy for improving production efficiency in chickens, particularly during the growth phase.

The feed conversion ratio (FCR), which reflects feed conversion efficiency, was also improved in subjects receiving 2% colostrum followed by 1% and 0%. A lower FCR value indicates better use of feed for body weight production. These results demonstrated the beneficial effect of colostrum on the digestive and metabolic efficiency of chicks. They are consistent with those of Mokhtarian et al. (2023), who observed a significant reduction in CI in Japanese quails fed a colostrum supplement. Regarding mortality rates, a reduction was observed in the treated subjects, particularly those that received colostrum during the first few

^{*}pas de différence significative entre ces valeurs, *** : la différence est hautement significative.

weeks. This could be explained by the immunostimulatory effect of colostrum, which strengthens the natural defenses of chicks during the start-up phase. These results are consistent with the conclusions of Afzal et al. (2017); Mokhtarzadeh et al. (2022); Arjomand et al. (2022), who emphasized that bovine colostrum contributes to improved survival of chicks and quails during critical phases, particularly at the start of life.

With regard to egg production, although the experiment focused mainly on the growth phase, certain early signs such as improved body uniformity and increased vitality in the treated subjects may have had a positive influence on the early laying performance of Goliath chickens. Previous studies in quail (Bayril et al. 2017; Mokhtarzadeh et al. 2022) have shown that early nutritional benefits can impact long-term reproductive performance, particularly egg quality and laying rate. Thus, hens that received 2% and 1% colostrum produced heavier eggs than those in the control group. This could be related to the overall improvement in the physiological condition of the supplemented subjects. This observation is consistent with the conclusions of Tougan et al. (2019), who showed that eggs from hens raised with the use of a growth promoter (DI Grow) were heavier than those from the control group.

V. Conclusion:

In summary, the incorporation of bovine colostrum into the diet of Goliath chicks had a significant effect on body weight during the first weeks of life, with a marked superiority for the 2% treatment followed by the 1% and 0% treatments, respectively. The addition of colostrum also promoted an improvement in average daily gain, reflecting better weight growth. In addition, an increase in feed intake and an improvement in feed efficiency (feed conversion ratio) were observed, particularly in chicks receiving 2% colostrum. These results showed better palatability and optimized utilization of the ration. With regard to egg production, no statistically significant differences were found between the treatments. However, the data show that the addition of bovine colostrum, particularly at 2%, had a beneficial effect on hen weight, egg production, and reduced mortality in the early stages. In view of the results obtained, it would be interesting to further investigate these findings in order to better understand the long-term effects of colostrum on zootechnical performance.

Abreviation:

ADG - average daily gain FCR - feed conversion ratio T0 - treatment 0 T1 - treatment 1 T2 - treatment 2

Conflict of interest

The authors declare that there are no conflicts of interest.

Authors' contributions

HA designed and planned the study; SHA and HHA collected the data and drafted the first version of the manuscript; SHA and HA revised all versions of the manuscript; J-LH coordinated and revised the first draft; SHA and AGT performed the statistical analyses and revised the first draft; HI, AII, BKH, and HM revised the first draft of the manuscript. HA coordinated the work from design to revision of the final draft of the manuscript.

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